Cogeneration in Brazil

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ANP - Brazilian National Oil Agency

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Brazil Overview

- World's 9th largest economy
- 1999 GDP ~ US$600 Bn
- 8.5 million km²
- 164 million people

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Energy framework in Brazil

Brazilian Energy Scenario

Primary Source	1998 - (10^3 boe/d)
Production	3,912
Oil – 29%	
NG – 5.5%	
Biomass – 25%	
Hydro – 43%	
Imports	853
Exports	0
Final Consumption	4,666

Brazilian Energy Scenario

Final Use	1998
Total (10^3 boe/d)	**4,666**
Residential	15%
Commercial	6%
Industrial	36%
Transport	21%

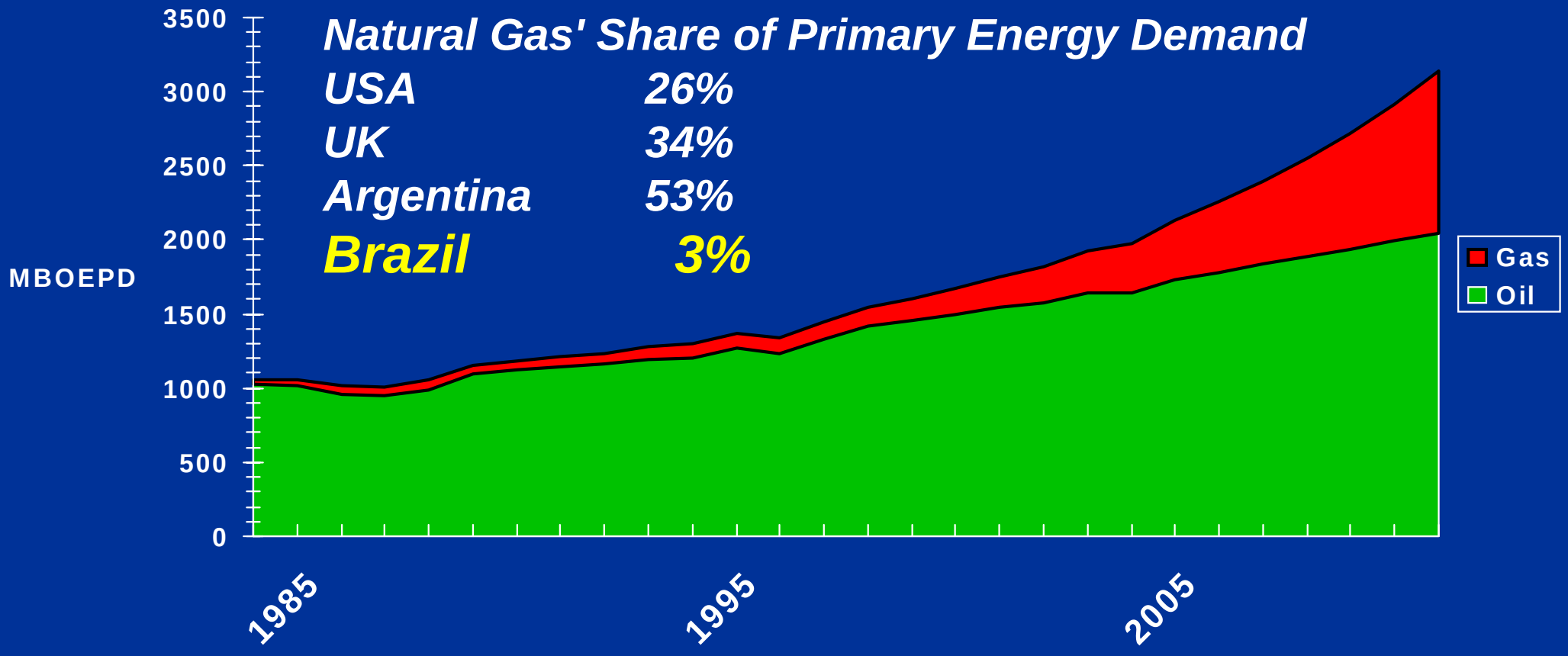
Fostering Natural Gas -An Evolving Energy Matrix

- **Policy: natural gas to represent 12% of the energy matrix by 2010**

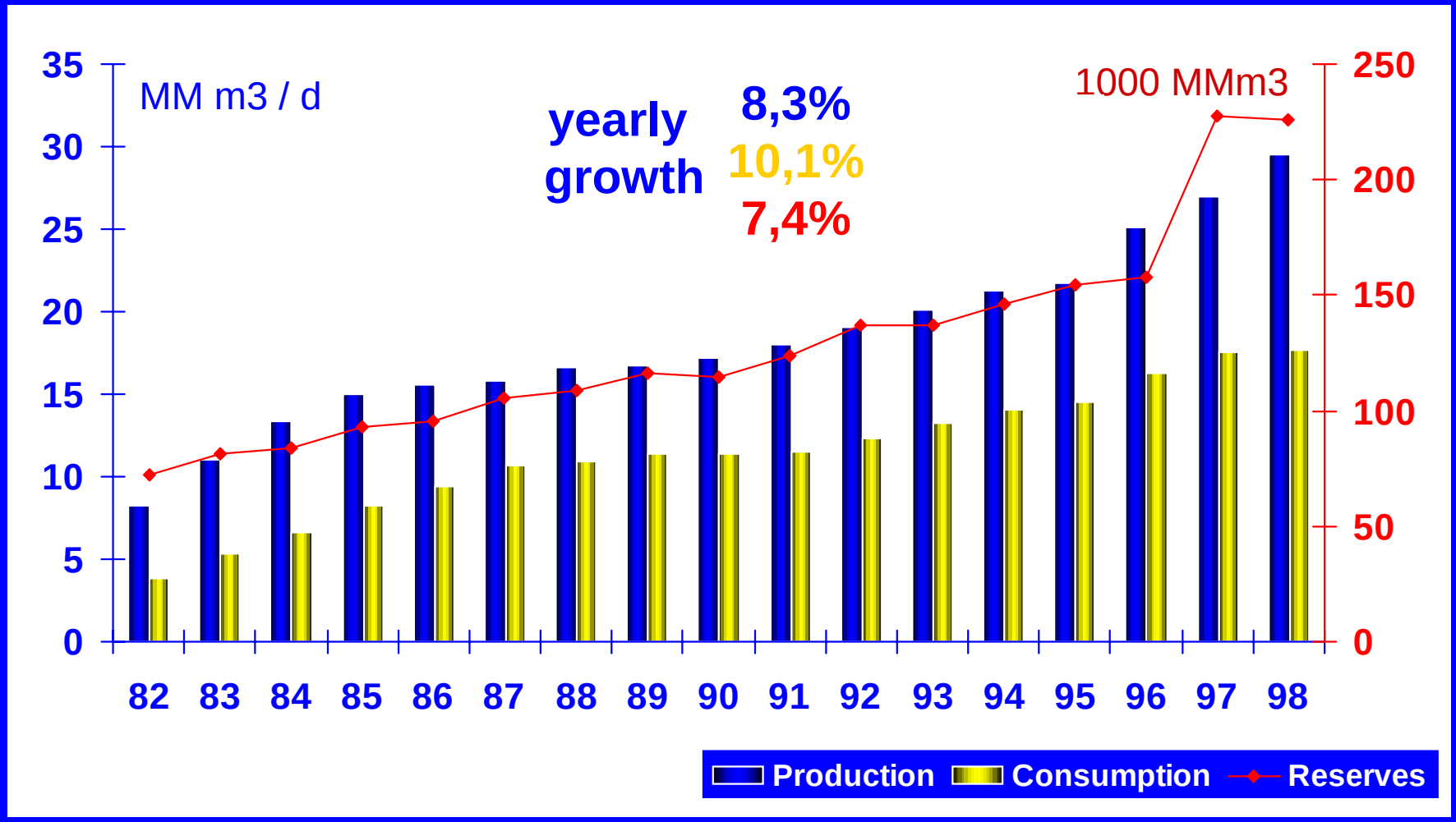
- **As of 1998, NG consumption was about 2.5% of the energy matrix :**
  - **total consumption - 18.3 MMm³/d**
    (including Petrobras use)
  - **LDC´s sales - 10.5 MMm³/d**

- **Total NG current production - 29 MMm³/d**

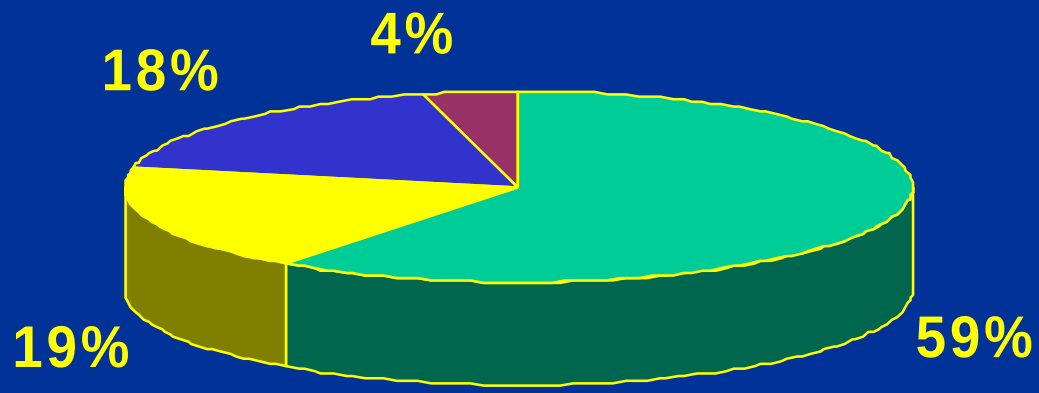
Participation of Natural Gas in the Energy Matrix



Natural Gas:
Production, Consumption & Reserves



Natural Gas Demand



***OBS*: Consumption:**

38,8 % - Petrobras

61,2 % - LDCs

Natural Gas pipelines

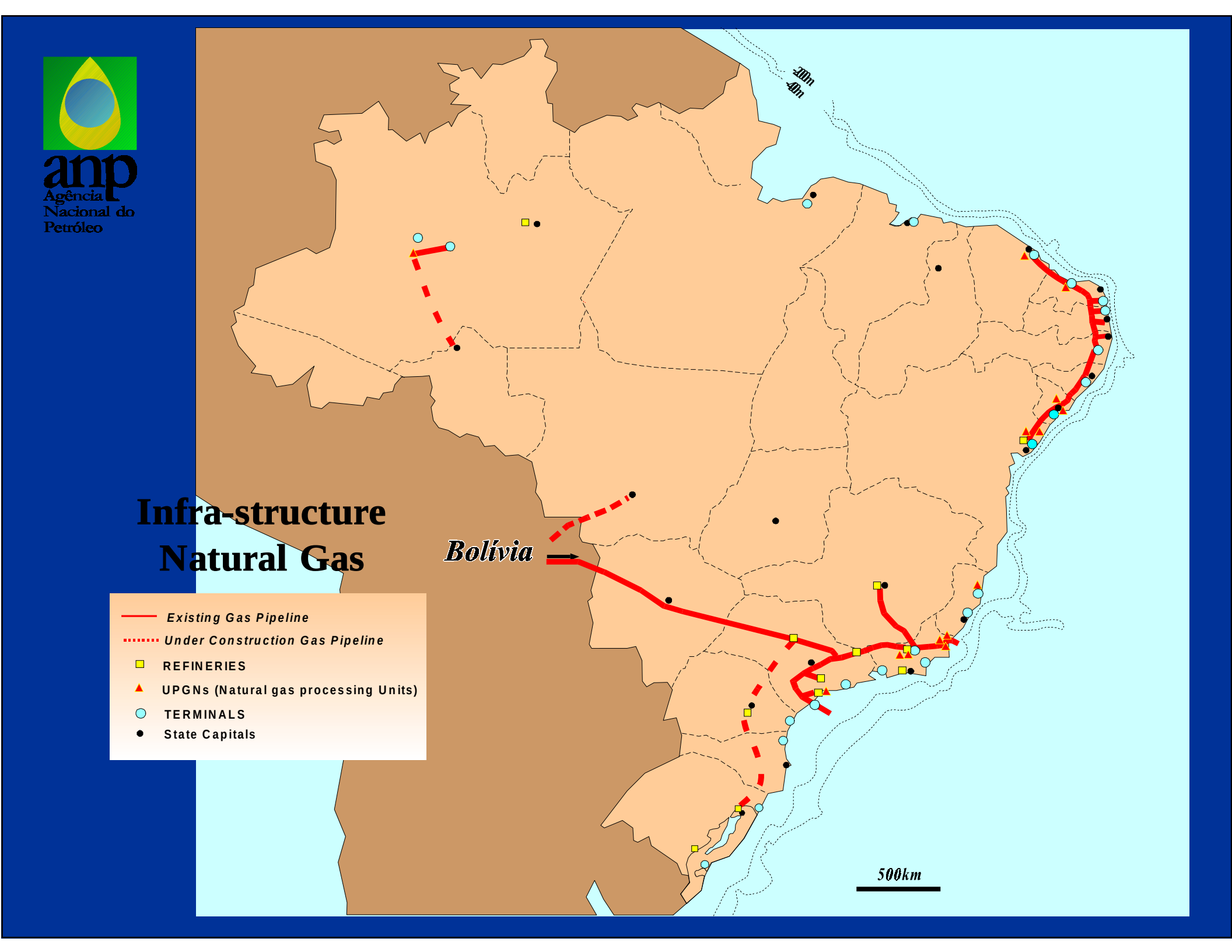
Transfer pipelines - 2180 km

Transport pipeline - 2400 km

Bolivia Brazil - 3150 km*

Distribution pipelines - 5000 km

** - Bolivian & Brazilian branches*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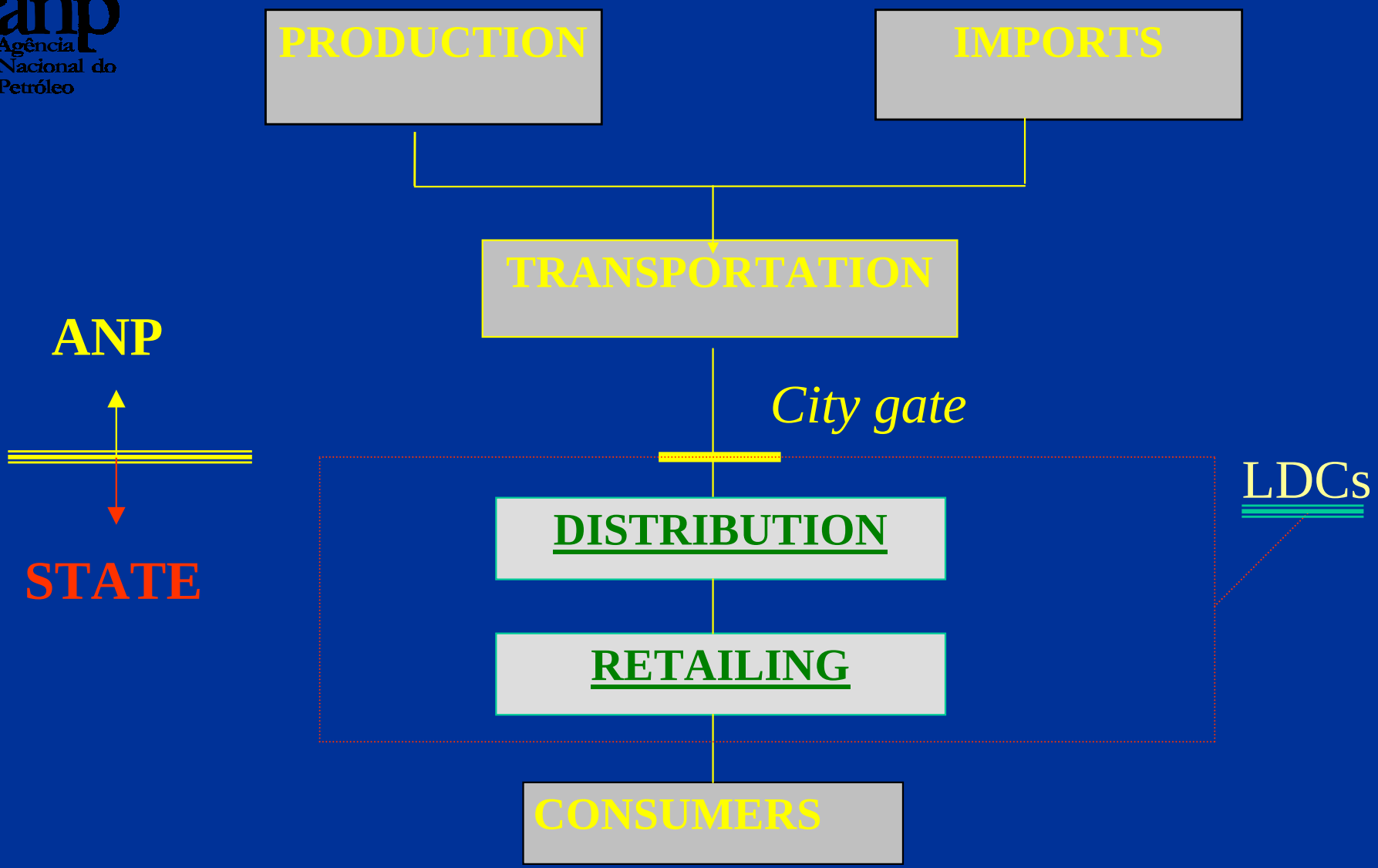
Infra-structure
Natural Gas
Bolívia
200m
400m
Existing Gas Pipeline
Under Construction Gas Pipeline
REFINERIES
UPGNs (Natural gas processing Units)
TERMINALS
State Capitals
500km

Applications for importing natural gas

	Country	Schedule	Volume	Potencial Market	Deliver
Enron	Argentina	1Q00	2,8 MM m3/day	UTE Cuiabá, MT	MT
AES - Transgás	Argentina	1Q00	12 MM m3/day	UTE RS, SP, MG e RJ	Porto Alegre
Petrobras - Gaspetro	Argentina	3Q00	12 MM m3/day	S e SE	Near Uruguaiana
Pan American	Argentina	3Q00	15 MM m3/day	UTE RS, SC e PR	RS, SC, PR
Sulgás	Argentina	4Q00	15 MM m3/day	RS	RS
Gaspetro	Bolivia	1Q99	30 MM m3/day	MS SP PR SC RJ RS MG	Corumbá
Petrobras	Nigeria	1Q04	3,8 MM m3/day	NE	NE
Shell	Nigeria	1Q04	3,8 MM m3/day	NE	NE

OBS1: Gas from Nigeria is LNG.

Natural gas market structure



Natural gas current use

Sector	%
Power plants	29.0
Residential/commercial	0.3
Transportation	0.1
Iron/metalurgy	24.2
Chemicals	14.5
Food & beverage	7.0
Textile	5.2
Others (use as energy)	19.7

Fostering Natural Gas: a prospective view

- **Domestic production and imports will lead to much more gas available**
- **Domestic production growing at very high rates (8% /y from 1990 to1999)**
- **Imports through Bolivia-Brazil Pipeline can be significantly increased**
- **Total Imports authorization summing up to 80 MMm^3/d**

Power Sector Situation

- **Projections 1999/2008:**
  - **Demand growth : 4.7% per year (>3 GW/year)**
  - **Thermoelectricity share: from 8.6% to 19% of the installed capacity**
  - **High deficit risks until 2003 - urgent need of investments**

- **Investments:**
  - **Realized in 1998: US$ 3 billion**
  - **Annual needs until 2003: US$ 4 billion**

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Cogeneration in Brazil

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Cogeneration in Brazil

- Conventional cogeneration - widespread use over different industrial sectors
- Relative small share of the market due to a previously unfavorable legal framework
- Room for improvements of conventional cogen plants
- Increasing participation of natural gas and gas turbines

Brazilian Cogeneration

Sector	1998 Installed Capacity (MW)	2003 Announced Additional Capacity (MW)
Sugar Cane Industry	995	205
Chemical and Petrochemical	413	5,580
Pulp & Paper	718	471
Metal and Steel	341	354
Total	**2,467**	**6,610**
Power sector installed capacity	**63,000**	

Perspectives on "new cogeneration"

- **Natural gas availability and policy**
- **Gas turbines competitiveness**
- **Commercial sector (eg.: shopping centers, hospitals) and small industries**

Barriers to be overcame

- **Power sector related:**
  - **A power sector mostly based on hydropower (low prices, high volatility)**
  - **PPA - market risk**
  - **Back-up rules**

    (partially defined last December, but still depending on spot market development)
  - **High wheeling rates**
  - **Connection requirements (small cogen)**

Barriers to be overcame

- **Natural gas sector related:**
  - **Missing infrastructure (incipient market)**
  - **Price and escalation adjustment**
  - **Very high costs for small cogeneration**
  - **Tax regime**
- **Financial constraints:**
  - **Lack of credit**
  - **Country risk**
- **Still changing institutional framework**

Conclusions

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Power sector situation → **Cogeneration is needed**

Natural gas availability → **Cogeneration is feasible and competitive**

Conclusions

Government commitment
- competitive market
- energy efficiency
- fostering gas in the energy matrix
- stable regulation

Cogeneration is deemed relevant

The changing environment at the energy sector is calling for new players.

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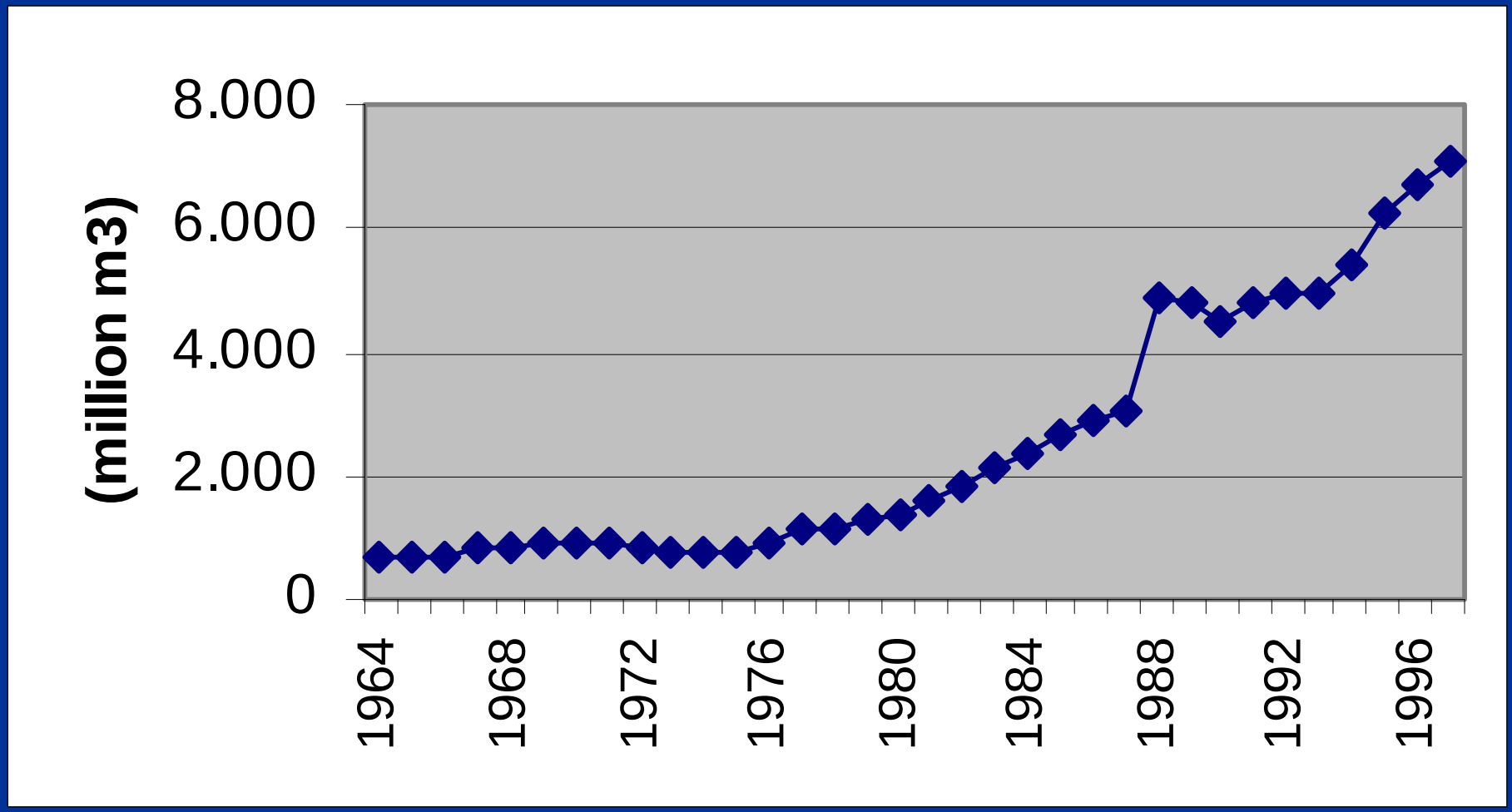
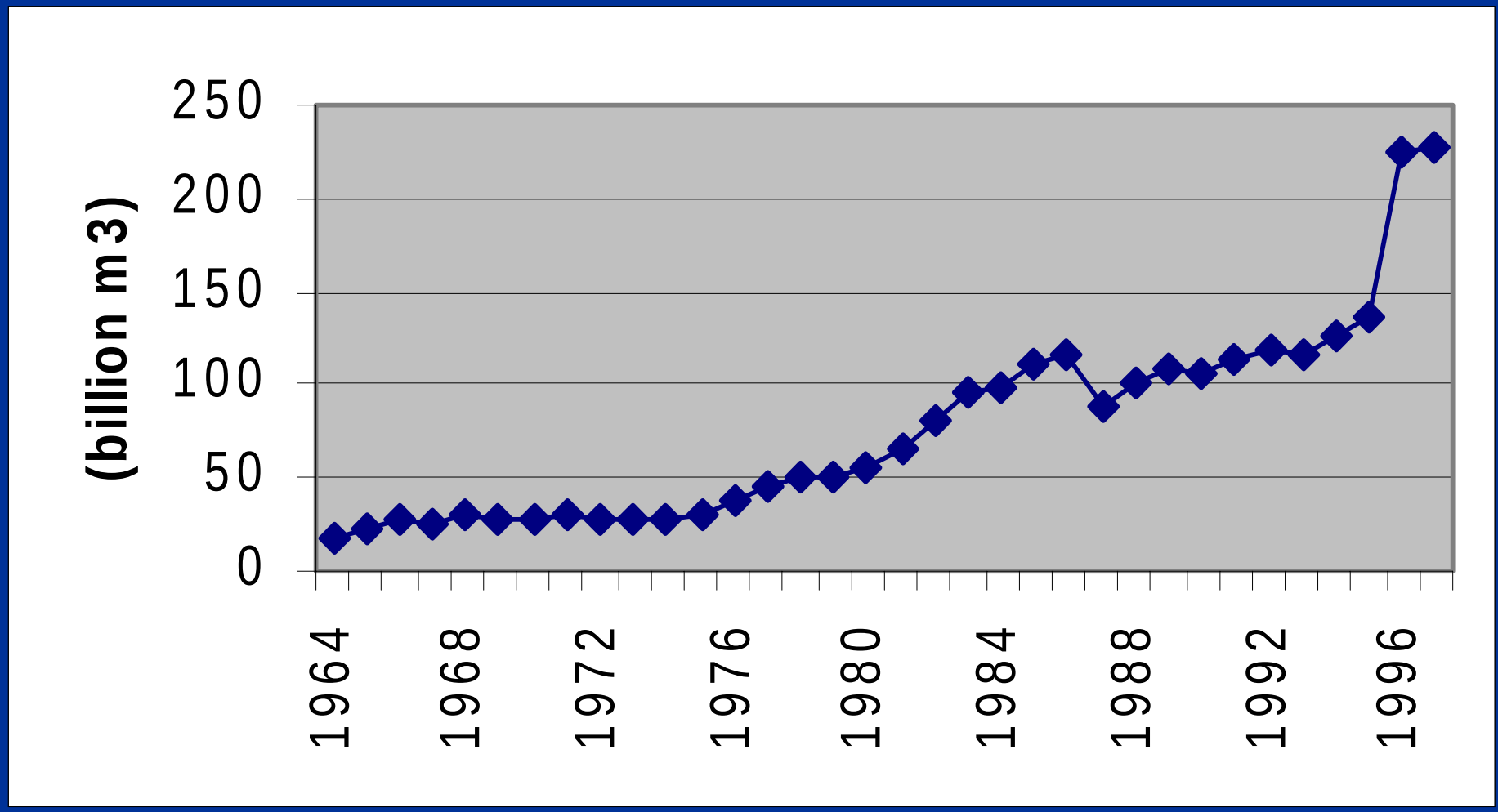
OIL PROVED RESERVE



GAS PROVED RESERVE



GAS PRODUCTION